



The Proceedings
OF
THE INSTITUTION OF
ELECTRICAL ENGINEERS

FOUNDED 1871: INCORPORATED BY ROYAL CHARTER 1921

ISSUED IN THREE PARTS AS FOLLOWS:

Part A. POWER ENGINEERING (*February, April, etc.*)

Part B. ELECTRONIC AND COMMUNICATION ENGINEERING (INCLUDING RADIO ENGINEERING)
(*January, March, etc.*)

Part C. INSTITUTION MONOGRAPHS (*March and September only*)

PART C

MONOGRAPHS NOS. 387-454

VOLUME 108, 1961

PUBLISHED BY THE INSTITUTION, SAVOY PLACE, LONDON, W.C.2

The Institution of Electrical Engineers

FOUNDED 1871
INCORPORATED BY ROYAL CHARTER 1921

PATRON: HER MAJESTY THE QUEEN

COUNCIL 1960-1961

President

SIR HAMISH D. MACLAREN, K.B.E., C.B., D.F.C.*, LL.D., B.Sc.

Past-Presidents

W. H. ECCLES, D.Sc., F.R.S.
THE RT. HON. THE EARL OF MOUNT EDGECUMBE, T.D.
J. M. DONALDSON, M.C.
PROF. E. W. MARCHANT, D.Sc.
H. T. YOUNG.
SIR GEORGE LEE, O.B.E., M.C.
J. R. BEARD, C.B.E., M.Sc.
SIR NOEL ASHBRIDGE, B.Sc.(Eng.).
SIR HARRY RAILING, D.Eng.
P. DUNSHEATH, C.B.E., M.A., D.Sc.(Eng.), LL.D.
SIR VINCENT Z. DE FERRANTI, M.C.

T. G. N. HALDANE, M.A.
PROF. E. B. MOULLIN, M.A., Sc.D., LL.D.
SIR ARCHIBALD J. GILL, B.Sc.(Eng.).
SIR JOHN HACKING.
COL. B. H. LEESON, C.B.E., T.D.
SIR HAROLD BISHOP, C.B.E., B.Sc.(Eng.), F.C.G.I.
SIR JOSIAH ECCLES, C.B.E., D.Sc.
THE RT. HON. THE LORD NELSON OF STAFFORD.
SIR W. GORDON RADLEY, K.C.B., C.B.E., Ph.D.(Eng.).
S. E. GOODALL, M.Sc.(Eng.), F.Q.M.C.
SIR WILLIS JACKSON, D.Sc., D.Eng., LL.D., F.R.S.

Vice-Presidents

B. DONKIN, B.A.
O. W. HUMPHREYS, C.B.E., B.Sc.
G. S. C. LUCAS, O.B.E., F.C.G.I.

C. T. MELLING, C.B.E., M.Sc.Tech.
A. H. MUMFORD, O.B.E., B.Sc.(Eng.).

Honorary Treasurer

C. E. STRONG, O.B.E., B.A., B.A.I.

Ordinary Members of Council

J. C. ARKLESS, B.Sc.
PROF. H. E. M. BARLOW, Ph.D., B.Sc.(Eng.), F.R.S.
D. A. BARRON, M.Sc.
C. O. BOYSE, B.Sc.(Eng.).
F. H. S. BROWN, C.B.E., B.Sc.
PROF. M. W. HUMPHREY DAVIES, M.Sc.
SIR JOHN DEAN, B.Sc.
L. DRUCQUER.
J. M. FERGUSON, B.Sc.(Eng.).
D. C. FLACK, B.Sc.(Eng.), Ph.D.
R. J. HALSEY, C.M.G., B.Sc.(Eng.), F.C.G.I.

R. A. HORE, M.A., B.Sc., Ph.D.
J. S. McCULLOCH.
PROF. J. M. MEEK, D.Eng.
THE HON. H. G. NELSON, M.A.
H. V. PUGH.
J. R. RYLANDS, M.Sc., J.P.
R. L. SMITH-ROSE, C.B.E., D.Sc., Ph.D., F.C.G.I.
G. A. V. SOWTER, Ph.D., B.Sc.(Eng.).
H. G. TAYLOR, D.Sc.(Eng.).
D. H. TOMPSETT, B.Sc.(Eng.).

Chairmen and Past-Chairmen of Sections

Electronics and Communications:

T. B. D. TERRONI, B.Sc.
†M. J. L. PULLING, C.B.E., M.A.

Measurement and Control:

C. G. GARTON.
†PROF. A. TUSTIN, M.Sc.

Supply:

E. L. ROBINSON, M.Sc.
†J. R. MORTLOCK, Ph.D., B.Sc.(Eng.).

Utilization:

J. M. FERGUSON, B.Sc.(Eng.).
†T. E. HOUGHTON, M.Eng.

Chairmen and Past Chairmen of Local Centres

East Midland Centre:

LT.-COL. W. E. GILL, T.D.
†D. H. PARRY, B.Sc.

North-Western Centre:

F. LINLEY.
†F. J. HUTCHINSON, M.Eng.

Mersey and North Wales Centre:

D. A. PICKEN.
†T. A. P. COLLEDGE, B.Sc.(Eng.).

Northern Ireland Centre:

J. MCA. IRONS.
†T. S. WYLIE.

Southern Centre:

R. GOFORD.
†W. D. MALLINSON, B.Sc.(Eng.).

North-Eastern Centre:

D. H. THOMAS, M.Sc.Tech., B.Sc.(Eng.).
†H. WATSON-JONES, M.Eng.

Scottish Centre:

R. B. ANDERSON.
†J. A. AKED, M.B.E.

† Past Chairman.

Western Centre:

A. C. THIRTLE.
†H. JACKSON, B.Sc.(Eng.).

North Midland Centre:

F. W. FLETCHER.
†PROF. G. W. CARTER, M.A.

South Midland Centre:

BRIGADIER F. JONES, C.B.E., M.Sc.
†G. F. PEIRSON.

Secretary

W. K. BRASHER, C.B.E., M.A., M.I.E.E.

Deputy Secretary

F. JERVIS SMITH, M.I.E.E.

Principal Assistant Secretary

F. C. HARRIS.

Editor-in-Chief

G. E. WILLIAMS, B.Sc.(Eng.), M.I.E.E.

CONTENTS

VOL. 108 Part C

1961

MONOGRAPHS Nos. 387-454

	PAGE		PAGE
Discussion on 'Extension of the Dual-Input Describing-Function Technique to Systems containing Reactive Non-Linearity' ..	1	A New Approach to Kron's Method of Analysing Large Systems. R. Onodera (No. 403) ..	122
An Analytical Method for Predicting the Performance of Semi-Enclosed Fuses. Colin Adamson, M.Sc.(Eng.), and M. Viseshakul, M.Sc.Tech. (No. 387) ..	2	Pole-Face Losses in Alternators. Prof. J. Greig, M.Sc.(Eng.), Ph.D., and K. Sathirakul, B.Sc.(Eng.), Ph.D. (No. 404) ..	130
Signal Flow-Graph Analysis and Feedback Theory. R. F. Hoskins, M.Sc. (No. 388) ..	12	Audio Communication with Orthogonal Time Functions. Henning F. Harmuth, Dipl.Ing., Dr.Tech. (No. 405) ..	139
The Received-Amplitude Distribution produced by Radio Sources of Random Occurrence and Phase. W. C. Bain, M.A., B.Sc., Ph.D. (No. 389) ..	20	The Physical Realization of Induction-Motor Equivalent Circuits. N. N. Hancock, B.Sc.(Eng.), M.Sc.Tech., and B. H. Karakaraddi, B.Sc., M.Sc.Tech. (No. 406) ..	145
A Brief Review of the Theory of Paper Lapping of a Single-Core High-Voltage Cable. P. Gazzana-Priaroggia, Dr.Ing., E. Occhini, Dr.Ing., and N. Palmieri, Dr.Ing. (No. 390) ..	25	Optimum Combination of Pulse Shape and Filter to produce a Signal Peak upon a Noise Background. H. S. Heaps, B.Sc., M.A. (No. 407) ..	153
A New Type of Piezo-Electric Flexural Vibrator in the Form of Balanced Cantilevers. Sheila Ayers (No. 391) ..	35	Discussion ..	531
Chain Codes and their Electronic Applications. F. G. Heath, B.Sc., and M. W. Gribble, B.Sc. (No. 392) ..	50	The Potential Distribution and Thermionic Current between Parallel Plane Emitters. F. H. Reynolds, B.Sc.(Eng.) (No. 408) ..	159
Frequency Response Analysis of the Stabilizing Effect of a Synchronous Machine Damper. A. S. Aldred, M.Sc., Ph.D., and G. Shackshaft, B.Eng., Ph.D. (No. 393) ..	58	Propagation along Unbounded and Bounded Dielectric Rods. P. J. B. Clarricoats, B.Sc.(Eng.), Ph.D.	
The Magnetic Field and Centring Force of Displaced Ventilating Ducts in Machine Cores. K. J. Binns, B.Sc. (No. 394) ..	64	Part 1.—Propagation along an Unbounded Dielectric Rod (No. 409) ..	170
An Analytical Review of Power-System Frequency, Time and Tie-Line Control. D. Broadbent, B.Sc., M.Eng.Sc., Ph.D., and K. N. Stanton, B.E. (No. 395) ..	71	Part 2.—Propagation along a Dielectric Rod contained in a Circular Waveguide (No. 410) ..	177
Discussion ..	532	The Launching of Surface Waves by a Magnetic Line Source. Prof. C. M. Angulo and Prof. W. S. C. Chang (No. 411) ..	187
The Magnetic Excitation inside a Cylindrical Thin-Film Ferromagnet. T. H. O'Dell, B.Sc. (No. 396) ..	79	The Output Spectral Density of a Detector operating on a F.M. C.W. Radar Signal in the Presence of Band-Limited White Noise. J. Lait, M.A., and A. J. Hymans, M.Sc. (No. 412) ..	197
Discussion on 'Flux Distribution in a Permeable Sheet with a Hole near an Edge' ..	82	Quantitative Treatment of Three-Phase Brush-Shifting Series Commutator Motor. O. E. Mainer, M.Sc.(Tech.) (No. 413) ..	208
The Conductivity of Oxide Cathodes.		The Algebra and Topology of Electrical Networks. P. R. Bryant, M.A., M.Sc., Ph.D. (No. 414) ..	215
Part 9.—Thermo-Electric Power. G. H. Metson, M.C., D.Sc., Ph.D., M.Sc., B.Sc.(Eng.), and M. F. Holmes, B.Sc. (No. 397) ..	83	The Surge Corona Discharge. R. Davis, M.Sc., and R. W. E. Cook. (With an Appendix by W. G. Standring, M.A.) (No. 415) ..	230
Part 10.—Spontaneous Generation of Negative Ions. G. H. Metson, M.C., D.Sc., Ph.D., M.Sc., B.Sc.(Eng.) (No. 443) ..	438	Temperature Rises in Electrical Machines with Sustained Variations in Load and Speed. B. J. Prigmore, M.A., M.Sc.(Eng.) (No. 416) ..	240
Part 11.—Thermal Stability of the Alkaline Earth-Oxides. G. H. Metson, M.C., D.Sc., Ph.D., M.Sc., B.Sc.(Eng.), and H. Batey (No. 444) ..	450	The Indeterminacies of Measurements using Pulses of Coherent Electromagnetic Energy. R. Madden, B.S. (No. 417) ..	247
Forced Oscillation in an Oscillator with Two Degrees of Freedom. B. R. Nag, M.Sc.(Tech.) (No. 398) ..	93	Numerical Evaluation of Inductance and A.C. Resistance. R. S. Mamak, B.Sc., and E. R. Laithwaite, M.Sc., Ph.D. (No. 418) ..	252
Matrix Analysis of Constrained Networks. A. Nathan, M.S., D.Sc.(Eng.) (No. 399) ..	98	Discussion ..	533
Discussion ..	536	Frequency Spectrum Distortion of Random Signals in Non-Linear Feedback Systems. Prof. J. C. West, Ph.D., D.Sc., J. L. Douce, Ph.D., M.Sc., and B. G. Leary, B.E., (No. 419) ..	259
Limitations on Realizable Response Shapes for certain Wide-Band Bandpass Amplifier Circuits. R. A. Woodrow, B.Sc. (No. 400) ..	107	Discussion ..	534
Application of the Theory of Orthogonal Polynomials in Two Variables to a Multi-Gain Equivalent Linearization Problem. J. L. Brown, Ph.D. (No. 401) ..	115	Stability of a Feedback System containing a Limited-Field-of-View Error Detector. D. P. Atherton, B.Eng. (No. 420) ..	265
Unstable Electron Flow in a Diode. R. J. Lomax, M.A., Ph.D. (No. 402) ..	119	Limitations of Distance-Type Protective Equipment when applied to Long Extremely-High-Voltage Power Lines. A. Wright, M.Sc. (No. 421) ..	271
		Interconnected Rotor Induction Motors. N. C. Enslin, Ph.D. (No. 422) ..	281

	PAGE		PAGE
Frequency Response of Feedback Relay Amplifiers. Ze'ev Bonenn, B.Sc. (No. 423)	287	Wide-Band Coupling Systems between a Waveguide and a Transmission Line. B. Rogal, B.Sc.(Eng.), and Prof. A. L. Cuilen, O.B.E., Ph.D. (No. 442)	433
Sign Matrices and Realizability of Conductance Matrices. Prof. G. Biorci (No. 424)	296	Transitional Electrical Units. Leo Young, Dr.Eng., M.A., M.S. (No. 445)	453
Travelling-Wave Analysis of Generalized Networks. J. Zawels, Ph.D. (No. 425)	300	Internal Waveform Distortion in Silicon-Iron Laminations for Magnetization at 50 c/s. Prof. F. Brailsford, Ph.D., and J. M. Burgess, B.Sc.(Eng.) (No. 446)	455
Optimum Sampled-Data Control. R. Jackson, M.A. (No. 426) ..	309	The Motion of Cold-Cathode Arcs in Magnetic Fields. A. E. Guile, Ph.D., B.Sc.(Eng.), T. J. Lewis, Ph.D., M.Sc., B.Sc.(Eng.), and P. E. Secker, Ph.D., B.Sc.(Eng.) (No. 447) ..	463
The Stability of Permanent Magnets. C. E. Webb, B.Sc.(Eng.) (No. 427)	317	Frequency-Response Analysis of Displacement Governing in Synchronous Power Systems. P. A. W. Walker, B.Eng., and A. S. Aldred, M.Sc., Ph.D. (No. 448)	477
Discussion	535	Analytical Determination of the Characteristics of Enclosed and Oil-Immersed Fuses. C. Adamson, D.Sc., M.Sc.(Eng.), and M. Viseshakul, M.Sc.Tech., Ph.D. (No. 449)	477
Topological Synthesis of Non-Reciprocal Resistance Networks. R. Onodera (No. 428)	325	The Launching of Surface Waves by an End-Fire Array of Slots. Prof. A. L. Cullen, O.B.E., Ph.D., and J. A. Staniforth, Ph.D. (No. 450)	493
The Impulse Response of a Number of Identical Circuits in Cascade. K. Tharmalingam, B.A., B.Sc. (No. 429)	335	Backward Waves in Waveguides containing Dielectrics. P. J. B. Clarricoats, B.Sc.(Eng.), Ph.D. (No. 451)	493
Microwave Propagation through Round Waveguide Partially Filled with Ferrite. A. J. Baden Fuller, M.A. (No. 430)	339	The Relation between Discrete Periodic Inputs, the Transfer Function and the Transient Response of a System. T. Glucharoff, M.E. (No. 452)	502
Microwave Hall Effect and the Accompanying Rotation of the Plane of Polarization. Prof. H. E. M. Barlow, B.Sc.(Eng.), Ph.D. (No. 431)	349	A Theoretical and Analogue Approach to Stray Eddy-Current Loss in Laminated Magnetic Cores. D. A. Jones, B.Sc., Ph.D., and W. S. Leung, B.Sc.(Eng.), Ph.D. (No. 453)	509
A Method of Calculating the Transfer Functions of Ladder Networks. N. Ream, B.A. (No. 432)	354	A Hunting Analysis of a Permanent-Magnet Alternator and a Synchronous Motor. M. H. Walshaw, B.Sc.(Eng.), and J. W. Lynn, M.Sc., Ph.D. (No. 454)	513
The Part Played by Surface Waves on the Reflection at a Ferrite Boundary. L. Lewin (No. 433)	359	Discussion on 'Orthogonal Codes'	522
The Surface Impedance Concept and the Structure of Radio Waves over Real Earth. Z. Godziński (No. 434)	362	Discussion on 'Calculation of the Current in Non-Linear Surge-Current-Generator Circuits'	529
The Analysis of Non-Linear Resonant Circuits. C. B. Newport, Ph.D., and D. A. Bell, M.A., Ph.D. (No. 435)	374	Discussion on 'Eddy-Current Effects in Rectangular Ferromagnetic Rods'	529
Design of Cylindrical Surface Waveguides with Dielectric and Magnetic Coating. T. Berceli, Dr.Eng. (No. 436)	386	Discussion on 'Electric and Magnetic Images'	530
A Broad-Band Waveguide Junction containing Dielectric. P. J. B. Clarricoats, B.Sc.(Eng.), Ph.D. (No. 437)	398	Index	537
Certain Approaches to Electromagnetic Field Problems pertaining to Dynamo-Electric Machines. K. C. Mukherji, B.E., Ph.D. (No. 438)	405		
A Note on Optimum Linear Multivariable Filters. R. J. Kavanagh, B.Sc., M.A.Sc., Ph.D. (No. 439)	412		
Factors affecting the Behaviour of an Electric Arc under Transient Conditions. I. A. Black, B.Sc.(Eng.), Ph.D. (No. 440)	418		
An Experimental Proton Linear Accelerator using a Helix Structure. D. P. R. Petrie, M.Sc., R. Bailey, B.Sc., D. G. Keith-Walker, B.Sc.(Eng.), H. Longley, B.Sc., and D. R. Chick, D.Sc. (No. 441)	424		

CORRIGENDA TO VOL. 108, PART C, 1961

Page 29: Eqns. (13) and (14):

 $\sqrt{n_{m-1}}$ should read $\sqrt{n_{m+1}}$

First unnumbered equation after eqn. (14a):

$$\left(\frac{R_p}{S_p} x^{-2\sqrt{n_p}}\right)^l \text{ should read } \left(-\frac{R_p}{S_p} x^{-2\sqrt{n_p}}\right)^l$$

Page 33: Table 1, col. 8:

 T/L should read T/L_s

Declaration on Fair Copying.—Within the terms of the Royal Society's Declaration on Fair Copying, to which The Institution subscribes, material may be copied from issues of the *Proceedings* (prior to 1949, the *Journal*) which are out of print and from which reprints are not available. The terms of the Declaration and particulars of a Photoprint Service afforded by the Science Museum Library, London, are published in the *Journal* from time to time.

Bibliographical References.—It is requested that bibliographical reference to an Institution paper should always include the serial number of the paper and the month and year of publication, which will be found at the top right-hand corner of the first page of the paper. This information should precede the reference to the Volume and Part.

Example.—SMITH, J.: 'Reflections from the Ionosphere', *Proceedings I.E.E.*, Paper No. 4001 R, December, 1954 (102 B, p. 1234).